

County, Massachusetts, or northern Vermont. Perhaps this is caused by an attempt, several years ago, to dig up the plants. When seen by the writer, one stalk had produced a single flower; two, a pair of blossoms; and one, three blooms. Three good capsules were ripening.

This orchid was discovered at the Hebron locality some twenty years ago (circa 1902) by Mrs. Andrew Morgan, through whose courtesy the station on her estate was revealed. Other parts of the same swamp failed to show any other Showy Lady's Slippers.

WELLESLEY FARMS, MASSACHUSETTS.

THE AMPHIBIOUS GROUP OF POLYGONUM, SUBGENUS PERSICARIA.

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I. ADAPTATION IN POLYGONUM AMPHIBIUM

THE ecological adaptations in the old-world *Polygonum amphibium* L. have been known longer and studied in greater detail than those of the species of corresponding habit in America. The following brief review of the principal literature indicates the scope and results of the chief observations and researches centering round the adaptations of this plant.

P. amphibium is indeed a classic example of adaptability to diverse conditions. The aquatic form is conspicuous in the European water-flora, and is probably the Potamogeton of the ancients. Among pre-Linnean writers the description of Ray¹ has been usually cited as the oldest extant recorded observation of the terrestrial and aquatic forms. Both were described by Linnaeus,² though not directly referred to in the *Species Plantarum* (1753). More recent European writers have described a number of forms, which may apparently be reduced for the present purpose to three, referable to *P. amphibium* var. *natans* Moench, Enum. Pl. Hassk. 28 (1777); var. *terrestre* Leers, Fl. Herborn. 99 (1775); and var. *maritimum* Detharding, Consp. Pl. Magn. Megal. Phan. 33 (1828). The first is the typical floating form, with coriaceous floating or emersed leaves devoid of hair except for the margin, flowering abundantly; the second an upright land-adaptation, with short-petioled rough-hairy leaves, flowering rarely

¹ Ray, *Historia Plantarum*, i. 184 (1686).

² L. Fl. Suec. 115 (1745).

but perennating rapidly by rhizomatiform more or less creeping stems; and the third a reduced and extremely hairy form of sand dunes and similar arid habitat, flowering still more rarely, according to Massart¹ never.

These peculiarities of *P. amphibium* have inspired a number of later European investigations and notes. Irmisch² observed and described seed-germination and the development of the seedling, noted the quack-like spreading habit of the plant, and commented upon the rarity of its fruiting. He described its heterostyly and noted that in the long-styled form the anthers produced little or no well-developed pollen and usually shriveled without opening. He found no blooming plant on really dry ground.³ He saw emersed plants with lower floating leaves of the type of var. *natans* and the upper foliage of var. *terrestre*. Hildebrand⁴ submerged the terrestrial form, whereupon the leaves died and the rhizome put out other branches which formed floating leaves. Hildebrand also described the distribution of stomata, in air-leaves few above and many below; in floating leaves all on the upper surface. Hoffmann⁵ repeated the experiment of Hildebrand, with similar results, but was unable again to produce the aquatic form from his plants with the induced terrestrial habit, even after they had been for two years transferred to two feet of water. Hoffmann also produced var. *maritimum* from var. *natans* by planting the latter in sand to which he added sodium chloride. An attempt to produce *P. aviculare* var. *littorale* from typical *P. aviculare* by similar means failed.

Schmidt⁶ and Schenck⁷ recorded observations on the assumption of the terrestrial form by formerly floating plants under the influence of drought. Constantin⁸ made extensive anatomical studies of stem-

¹ Massart, *L'Accommodation individuelle chez Polygonum amphibium*. Bull. Jard. Bot. Brux. i. 72-88 (1902).

² Irmisch, *Ueber Polygonum amphibium*, etc. Bot. Zeit. xix. 105-109 (1861).

³ Notes on the sterility of the land-forms constantly recur in the European literature, and similar observations are made concerning the terrestrial forms of the North America *P. natans*. Reduction of reproductive capacity following change of environment has perhaps attracted more attention among animals than plants, but the phenomenon exemplified by *P. natans* and *P. amphibium* is by no means an isolated one in the vegetable kingdom.

⁴ Hildebrand, *Ueber die Schwimmblätter von Marsilia und einigen anderen amphibischen Pflanzen*. Bot. Zeit. xxviii. 17-23 (1870).

⁵ Hoffmann, *Untersuchungen über Variation*. Ber. der Oberhessisch. Gesellsch. f. Natur u. Heilkunde. xvi. 1-37 (1877).

⁶ Schmidt as quoted by Schenck, Massart and others.

⁷ Schenck, *Die Biologie der Wassergewächse*. Verhandl. Naturhist. Vereines d. preuss. Rheinl. xlii. 217-280 (1885).

⁸ Constantin, Ann. Sci. Nat. sér. 6, Bot. xix. 287-331 (1884); Bull. Soc. Bot. Fr. xxxii. 83-88 (1885); Ann. Sci. Nat. sér. 7, Bot. iii. 94-162 (1886).

structure, epidermal characters, and the leaf-structure of terrestrial and aquatic forms. He successfully repeated Hildebrand's experiment, using different portions of the same plant, which he planted in terrestrial and aquatic environments. Volkens¹ also investigated and figured the anatomical differences in the stem and leaf of aerial and water forms. His figures include an enlargement of the peculiar short stiff bristle-like hair that forms a striking characteristic of the European *P. amphibium* when contrasted with the longer and weaker ones of its American counterpart.

Massart² interested himself particularly in the xerophile form (*P. amphibium* var. *maritimum*). He carried on cultural experiments to prove that the three varieties were merely adaptive states which could be made to pass at will from one to the other. He figured cross-sections of the leaves and stems of aquatic and xerophile types, the epidermal characters, and various types of hairs from the three forms.

As to the systematic rank of these well-known ecological forms, most European treatments term them varieties rather than formae. Moss³ reduced the var. *terrestre* to formal rank, and inasmuch as this disposition seems best to accord with the systematic plan adopted in the International Code, in the taxonomic portion of the present study both the water- and land-adaptations of *P. amphibium* are treated as formae.

In addition to its adaptability to various habitats, it appears that the European plant—in common with a considerable number of other plants of that continent—is a rather more aggressive weed than its American relatives. Leers,⁴ who found the terrestrial form growing “in cultis in der Pitze & vor dem Homberg” termed it vigorously “pessimum vitium.” At a much later date Compton⁵ reported a rather striking instance of the pioneering ability of the aquatic form. Twenty-four square miles of East Anglian fenland was flooded from January to October, 1915 so as

“to extinguish the centuries-old terrestrial flora . . . and to replace it by an aquatic flora derived from the waters of the drainage-channels”

¹ Volkens, *Zur Kenntniss der Beziehungen zwischen Standort und anatomischen Bau der Vegetationsorgane*. Jahrb. König. Bot. Gart. Berl. iii. 1-46 (1884).

² Massart, l. c. (1902).

³ Moss, *Camb. Brit. Fl.* ii. 115 (1914).

⁴ Leers, *Fl. Herborn.* 99 (1775).

⁵ Compton, *The Botanical Results of a Fenland Flood*. *Journ. Ecol.* iv. 15-17 (1916).

"*Cladophora flarescens* covered a very large proportion of the flooded area, acres at a stretch, either pure or mixed with *Polygonum amphibium*. The latter occurred in considerable abundance, rooting in the peaty soil, and producing branches often eight feet long (an indication of the depth of the flood) which bore fruit and seeded freely. In many cases these plants were so frequent that their leaves must have formed a thick coating to the water."

In this flooded area *P. amphibium* and *Alisma Plantago-aquatica* were the most abundant seed-plants.

(*To be continued.*)

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